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## Landscape Study in Wireless and Mobile Learning in the post-16 sector

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# Landscape Study in Wireless and Mobile Learning in the post-16 sector

**This is a series of 4 reports produced as outcomes of the Landscape Study in Wireless and Mobile Learning, funded by JISC through the Innovation strand of the JISC e-Learning Programme, 2004-5. The project was a collaboration between The Open University (Agnes Kukulska-Hulme and Diane Evans) and Wolverhampton University (John Traxler).**

## **Summary**

Authors: Agnes Kukulska-Hulme, Diane Evans **and** John Traxler

## **Current Uses of Wireless and Mobile Learning**

Lead Author: Agnes Kukulska-Hulme

## **Potential Uses of Wireless and Mobile Learning**

Lead Author: Diane Evans

## **Strategic Aspects of Wireless and Mobile Learning**

Lead Author: John Traxler

# Landscape Study in Wireless and Mobile Learning in the post-16 sector

Summary  
May 2005

Agnes Kukulska-Hulme, The Open University  
Diane Evans, The Open University  
John Traxler, University of Wolverhampton

## 1. Introduction

There is a swell of interest across the post-16 sector (further and higher education, and adult and community learning) in seeking to understand how the new wireless and mobile technologies can contribute to improving the student experience of learning, and help institutions fulfil their missions in an age of incomparably fast technological change. In the context of this interest and growing need, a Landscape Study project was commissioned by JISC through the Innovation strand of the JISC e-Learning Programme in 2004-5.

Our project aims were to take a birds-eye view of developments and practice in the UK and internationally, and to communicate our findings to a broad and varied audience. 'Wireless and mobile learning' is characterised by technical terminology and for those who are new to it, it can be hard to find a 'way in' to the subject. We have focused as much as possible on learners and institutions. A key objective was to deliver short overviews that could be read quickly, and could facilitate discussion in the post-16 sector, secure in the knowledge that a lot of background work had gone into distilling knowledge from many sources.

The study comprised three strands of investigation: current uses of wireless and mobile technologies, potential uses, and strategic implications. We were able to undertake this work by making it a collaborative enterprise between The Open University and the University of Wolverhampton. Both universities already had considerable experience of research and practice in this area, and a desire to share our knowledge across the sector. To conduct the study, we reviewed existing published literature, case studies, and project websites, and held conversations with a range of people across the post-16 education sector and in commercial organisations. A one-day Think-tank meeting was also held to debate emerging key questions with experts who have been working in wireless and mobile learning for several years.

The present document summarises the findings of our study, in terms of the three strands. It should be read in conjunction with the 'reviews' for each of the three strands of the study, which are available online at [www.jisc.ac.uk/eli\\_outcomes.html](http://www.jisc.ac.uk/eli_outcomes.html). The reviews give references to further reading. For a more 'ground level' picture of current uses of wireless and mobile technologies, we recommend the set of 10 case studies (with 5 video case studies) that were also produced within the Innovation strand during 2004-5, and are available online at [http://www.jisc.ac.uk/eli\\_oucasestudies.html](http://www.jisc.ac.uk/eli_oucasestudies.html).

We define wireless and mobile learning as learning delivered, enhanced or supported mainly or solely by wireless and mobile devices and their technologies. This learning may happen when a learner is not at a fixed, pre-determined location. This is however a rather limited definition and one with too much emphasis on the technologies and too little emphasis on the learning. We hope that a definition that focuses more on the learning and the experiences of the learner - experiences that include portability, privacy, spontaneity, situatedness and informality - will gradually emerge as the technologies become more powerful, pervasive and reliable, and less novel and conspicuous.

## **2. Current uses of wireless and mobile technologies in teaching and learning**

### **2.1 Reasons for using wireless and mobile technologies**

To understand current uses of wireless and mobile technologies, we have to ask what motivates teachers, learners and organisations to make use of these new technologies. The reasons are somewhat related to the choice of actual devices, as 'wireless and mobile' covers a very wide range of possibilities.

The devices are relatively inexpensive, they offer the possibility of ubiquitous (anywhere, anytime) computing, they promote information literacy, help with collaborative learning, and they also support independent learning. Other reasons include: assisting with students' motivation, helping organisational skills, encouraging a sense of responsibility, acting as reference tools, tracking students' progress, and for assessment. A range of environmental factors and trends also comes into play, such as the widespread adoption of mobile devices, the changing strategic demands of the educational environment, and developments in pedagogy.

Information about reasons for using wireless and mobile devices is often found in individual published trials and case studies, e.g. in the [JISC Case Studies in Wireless and Mobile Learning in the post-16 sector](#) (2005), which included the use of various devices as well as some specially designed or adapted 'learning spaces'. It is possible to identify three key reasons for using wireless and mobile technologies in post-16 education: improving access (e.g. for those who are dispersed geographically), making changes in teaching and learning (e.g. support differentiation of student learning needs), and alignment with institutional or business aims (e.g. to improve retention and achievement).

### **2.2 Main types of uses**

It is reasonable to enquire whether wireless and mobile devices can be used for existing activities, and what difference they can make, e.g. do they enable new kinds of learning? Naismith *et al.* (2004) have demonstrated that mobile technologies can relate to 6 different types of learning, for example behaviourist (quick feedback or reinforcement), constructivist (e.g. mobile investigations), situated (in an authentic context), collaborative (communication and information sharing), and so on. The new technologies enhance and extend teaching, learning and support activities, and over time we may see them multiply. Context-aware environments (where context-specific information is made available or used by learners as they move around) and immersive activities are opening up possibilities for new kinds of learning experiences. The ongoing nature of mobile collaboration and lifelong learning are creating the potential for the emergence of new attitudes and new outcomes that are only just beginning to be described or named.

Our review of literature and our investigations of wireless and mobile learning also suggest to us that the new technologies are particularly suited to certain kinds of activities or outcomes, for example skill building, self-evaluation, mentoring, electronic portfolios, or study management. They can help connect workplace learning with institutional learning and help widen access to a broader range of potential students. Three keywords that seem to sum up key benefits are: *portability*, *connectivity*, and *convenience*.

### **2.3 Impacts on teaching, learning and assessment**

Basic handheld computer functionality is currently insufficient to support the level and richness of discussion and interaction amongst students that a more student-centred conception of teaching would envisage. Nevertheless collaborative learning is already becoming more common, for example where learners are able to carry around their portable devices in groups and to communicate verbally.

Teachers are now finding themselves in situations where they need to focus more on:

- identifying and catering to students' specific knowledge needs
- fostering reflection on learning processes
- helping with the management of learning
- monitoring performance
- developing new strategies for consolidation of learning and assessment.

Practitioners have to find time to understand new student attitudes, new audiences and different patterns of study as well as having to grasp the possibilities of the new technologies. Lack of time, and shifts in the ways that time is allocated and used, are recurring issues.

Why would practitioners engage with this technology? Benefits that teachers are likely to see include increased student motivation and participation, better retention and achievement. In some situations there will be easier monitoring of performance, and they are likely to see higher interaction levels, which may be most noticeable in collaborative groups and in larger classes. Communication channels between staff and students, and among students, are becoming more complex but also offer a more flexible range of options, e.g. email, SMS, voice messages, online or mobile discussion forum.

Those learners who have access to mobile and wireless technologies have an additional means of communication and are able to share information with others. However, currently only mobile phones are owned by large proportions of learners.

In an era when education is increasingly multicultural, global and widely accessed, we need to remember that the experience of educators working with non-traditional university entrants, with overseas course participants and working outside Europe, North America and Australasia – will often be very different.

### **3. Current benefits for learners**

#### **3.1 Examining the evidence**

What evidence is there of any benefits derived from the use of these new technologies? How is evaluation being done? Evaluations typically include questionnaires, interviews, discussions or focus groups. A few studies use specific technologies to capture student reactions or to monitor usage. Problems collecting desired data are also sometimes reported in these studies, e.g. students failing to return questionnaires or software issues preventing transmission of monitoring data.

There is no agreed method and there are no widely used novel tools for collecting evaluation data. With the exception of cutting edge research projects, data collection largely relies on established methods in educational research and some exploitation of new technology. The latter requires skills that are being developed by researchers but that most teachers would not currently have at their disposal when evaluating their practice. It is also important to be cautious about generalizations being made at this early stage of use of the new technologies.

#### **3.2 Learners' experiences and outcomes**

A number of case studies have identified benefits to learners, such as immediate and regular feedback, increased engagement and motivation, a better fit with collaborative and group work tasks, access for off-campus communities, or outreach to learners who would not normally have access. These are derived from the use of particular technologies in particular contexts, nevertheless these are commonly reported benefits of current uses.

Outcomes for learners are often discussed in terms of the development of skills (e.g. reflective, oral, social, peer review, independent learning, ICT). Students are able to keep in

contact with a peer group whilst on work placements, and they may see themselves as becoming more efficient and productive learners. Continuity of content - availability in college and at home - encourages consolidation and familiarity with learning material. Portability allows learners to borrow a PDA in order to complete missed work.

## **4. Reflecting on current practice**

### **4.1 Issues noted in reviewing current uses**

Provided that equipment is working reliably, learners appear to respond well to the new technologies. However, set against the benefits are a number of issues that are being reported. Top of the list in case studies are current technical limitations such as battery life, which require educational activities to be adapted to new constraints. Practitioners are asking themselves whether the new devices are suitable for all learning styles and the extent to which this may affect take-up. The impacts on learning spaces are beginning to be addressed.

Collective experience to date indicates a number of potential pitfalls in using wireless and mobile technologies for teaching and learning, e.g. lack of success may be due to inappropriate use for a given pedagogical context, loaned devices may lose the benefits of personalization, and students may abandon their use of mobile technologies if they believe their social networks to be under attack. Mobile activities may not correspond with either the teacher's agenda or the curriculum.

It is also noted that educational practices are being affected in a number of ways, for example there is now a broader range of where learning takes place, and increasing emphasis on filling small gaps of time. It is also clear that it takes time for new patterns of use to evolve, and lecturers need to become 'device-aware', i.e. to understand the potential, the features and limitations of wireless and mobile devices.

## **5. Potential uses of wireless and mobile technologies**

### **5.1 Future needs and opportunities in post-16 education in learning and teaching**

The reform of the 14-19 curriculum, which offers the possibility for students to study and work at various locations as part of their course, will create a mobile group of learners. Most of this group of learners already use mobile phones for communication as part of their social environment. There is the potential for mobile devices to play a key role in supporting learners at this stage enabling them to

- access learning records,
- register attendance,
- download learning materials,
- keep in touch with subject and specialist teachers / tutors,
- be part of a learning community.

Where there is a requirement to collect evidence of skill competency to support assessment students could use mobile devices with sound, camera and video recording facilities. These could be sent to their tutors for comment and kept within a portfolio of evidence.

Initiatives for widening participation in HE are likely to require institutions to provide more flexible delivery and study of courses to satisfy the needs of this wider audience. Many students need to carry out their studies in parallel with some form of paid employment and may seek to engage with their studies in a way that is more flexible in terms of time and place.

Opportunities for lifelong learning enable the learner to control their learning. They can determine not only what, when and where they will learn but their level of engagement at any time, frequently moving in and out of different learning situations. There is likely to be a requirement for 'bite-sized' learning. Content for this may be suitable for rendering and delivery on small mobile devices.

Where there is a need for assessment this will reflect the smaller units of learning and may take the form of self assessment activities, online quizzes etc. which could take place equally on mobile devices or traditional PCs. Where progression is controlled by accreditation of prior achievements then it would require the results from bite-sized learning assessments and activities to be accessible via a learner's electronic portfolio.

## 5.2 Models of learning

The main teaching paradigm for many years, particularly in secondary and higher education, was the transmissive model. This model of education focuses on content delivery and is both discipline focussed and originating from the teacher. Many teachers have adopted the constructivist approach which views learning as an active process, based on the learner's current understanding or intellectual paradigm. Knowledge is constructed by assimilating new information into the learner's knowledge paradigm often modifying the model that already exists. Thus for learning to take place the learner needs to take an active rather than passive role.

Recent shifts in educational paradigms include:

- From constructivism to social constructivism
- From knowledge production to knowledge configuration

Social constructivism is an alternative approach to the content approach and is based on communication. Learning is seen as the result of active participation in a 'community' where new meanings are co-constructed by the learner and his / her community. Where this community covers diverse locations, mobile devices offer advantages in supporting ad hoc communications coupled with portability. They offer mobile learners opportunities to interact and to communicate with their peers when they are not co-located.

## 5.3 Future models

Two new models of learning paradigms have been identified during this study; 'navigationism' and 'connectivism'.

Tom Brown (2005) proposes a learning paradigm where the emphasis is on knowledge navigation.

*'Knowledge navigation is the central issue of what teaching and learning is about - thus the focus of learning is on 'navigating' in the ocean of available knowledge'*

Successful learning takes place when learners are able to solve contextual real life problems by actively engaging in problem solving activities within a collaborative framework. To enable this, learners need to work together to explore, evaluate, manipulate, integrating and navigate available information.

George Siemens (2004) presents a view of learning through Connectivism:

*'Connectivism is driven by the understanding that decisions are based on rapidly altering foundations. New information is continually being acquired. The ability to draw distinctions between important and unimportant information is vital. The ability to recognize when new information alters the landscape based on decisions made yesterday is also critical'*

The key components of connectivism are social networks and within these are key people who are well connected and can foster and maintain the knowledge flow.

Communication and access to information play key roles in both these views on learning. Mobile devices offer portable solutions as they support both synchronous and asynchronous communication. Using wireless technology, mobile devices can enable the learner to interact with online communities offering access to information on a need to know basis. Their software supports the maintenance of contact information for both individual and group.

## **5.4 Promising areas of development**

Conference proceedings and research papers offer a good insight into aspects that are the focus of discussion and investigation. We can see that the mobile learning research community is currently reflecting on aspects such as collaboration and community; content for mobile learning; technical innovations, reaching new kinds of learners, and understanding the field of mobile learning.

There has been a wide diversity in the focus of research projects focussing on mobile devices, many of which have been creating new educational opportunities, including:

- Delivery of relevant content based on the position of the learner which is determined by positioning systems
- Delivery of content based on a learner profile
- Enabling the learner to contribute to a pool of location specific information using public authoring systems
- Using wearable computing to support workers in practical hands-on situations.
- Using gaming situations to promote collaborative activity
- Creating virtual environments to enable learners to experience and interact with them

In the technical field we can see advances in the functionality of the different mobile devices. For example mobile phones and PDAs are increasingly offering the same functionalities, as they compete for the market. Microsoft has declared an interest in the educational market for mobile devices and there are reports of a new, much smaller, form of the Tablet PC.

Latest versions of multimedia format (MPEG4) and wireless networks (WiMAX) have not yet filtered through to handheld mobile devices and the education environment. It is likely that they will be picked up for exploration in future projects.

Technology advances driven by the 'gaming' software are suggesting possibilities for both collaborative and immersive experiences within educational contexts. This may prove to be where the most innovative contributions to learning will take place.

Practitioner involvement in the developments of mobile devices and in applications and technology to run on them will determine pedagogic soundness. This would enable communication and collaboration to play their part in any new teaching and new learning paradigms.

## **5.5 Visions and opportunity**

At a recent Think-tank Day organised through this project several specific features of mobile devices were identified which were felt added benefits to the learning experience. These were:

- privacy for the individual
- support for individual learning style
- immersion in learning activity
- facilities to capture data
- location or context enabled features, providing relevant content to the learner e.g. determined by their physical location



- user control of learning, by determining when and where they will participate.

Not all subject disciplines or courses will offer the same potential for using mobile devices nor will their use automatically benefit all courses. However to benefit from the use of mobile and wireless technologies teachers, and learners, need to

- adapt and use technology to optimise learning
- focus on the innovative / transformative use of technologies
- perceive value in their use
- rethink the discipline to take advantage of the technologies
- integrate the learning with the technology
- think about data depth, to provide content which will lock the learner into the subject.

The crucial considerations are:

- Is technology driving learning or are we adapting and using technology to optimise learning?
- Are we slapping new technological tools onto old teaching methods or are we focusing on the innovative / transformative use of technology in new teaching and new learning paradigms?

## 6. Strategic Aspects of Wireless and Mobile Learning

The strategic aspects are governed by concerns different from those of technology, learning and teaching. They are the context and the environment for the technical and the pedagogic aspects and include:

- *Resources*: meaning finance and money but also human resources, physical estates, institutional reputation, intellectual property and expertise.
- *Culture*: meaning institutions as social organisations, their practices, values and procedures, but also their culture, that is the expectations and standards of their staff, students and their wider communities

Implementing wireless and mobile learning within further, higher and community education must address the social, cultural and organisational factors. These can be formal and explicit or informal and tacit and can vary enormously across and within institutions.

### 6.1 Themes

Institutions hoping to enhance and support learning with wireless and mobile technologies will need to recognise the significance of a range of themes, identified below.

#### Projects

Projects are fixed-term and small-scale, with specific funds, expertise and enthusiasm. Projects refine or answer specific research questions, demonstrate technological or pedagogic possibilities and generate academic output. In current projects, wireless and mobile learning are usually implemented as enhancements to core provision, often as a variation of e-learning rather than as a new form of pedagogy. The most exciting, innovative and convincing examples of wireless and mobile learning are projects where new forms of learning are created, rather than existing forms of learning reversioned. Projects are a useful way to gain experience of wireless and mobile learning.

#### Niches

Niches are small-scale but sustainable, sometimes growing out of successful projects, based

around a limited number of funding models. These models include:

- Specific subjects, for example, nursing, teaching practice, where funding comes via training/professional agencies.
- Specific pedagogies, for example, fieldwork, outdoor pursuits, work-based learning, and for example, reflective logs, self-evaluation, e-portfolios.
- Particular constituencies of learners who are prioritised and/or resourced, for example,
  - the Widening Participation constituencies where public funds support an inclusion agenda or
  - full-cost courses, for example MBAs, where institutions use wireless and mobile learning to add value.

An understanding of the possibilities for sustainable wireless and mobile learning will allow institutions to support specific learners and specific learning in a sensible and effective fashion.

### **Producers, Manufacturers and Developers**

The wider world of wireless and mobile technologies has considerable influence on the effective and increased deployment of wireless and mobile learning. The champions and managers of wireless and mobile learning within further and higher education must be alert for trends and developments.

Many hardware manufacturers see their mainstream wireless and mobile markets as technology-driven, highly segmented and very volatile, whilst seeing the further and higher education markets as fragmented and opaque, working to timescales, budgets and priorities unlike those of any retail or commercial markets. It would be beneficial for learners if there were increased communication between producers, manufacturers and developers on the one side and education on the other, and there is a role for a national forum.

Some of the few developers of software and content for mobile platforms predict a continuation of project-based funding, focussing on engaging new learners and delivering standalone content. The issue of standards is however problematic, since many of the technologies are immature, unstable and short-lived, requiring considerable developmental agility. Institutions should treat the standards issue pragmatically in order to encourage experimentation and evaluation.

### **Institutional Perspectives**

In order to deploy wireless and mobile learning on a larger and sustained basis, its champions must present their case in ways that address parity with other provision and delivery in terms of institutional concerns such as:

- costs, funding, resourcing
- quality, fitness-for-purpose
- stability and reliability
- monitoring and evaluation
- legal expectations

Within an institution, several different bodies may articulate these various concerns and determine progress on an issue as potentially pervasive and systemic as wireless and mobile learning. The 'ownership' of the relevant policies usually resides with a different institutional custodian, such as the IT, QA and HR departments and their activities interact and interlock in ways that can slow down innovation and improvement.

Technical staff are usually the custodians of institutional IT policy and are responsible for issues such as network security, hardware maintenance, interoperability, software support and IT procurement. All of these are potentially problematic.

A wider acceptance for student and staff 'own' devices is one way that technical staff can reduce pressure on their own resources, and this is especially significant if institutions are to exploit the increasing ownership of handheld computers and smartphones. The reluctance of some technical staff to allow academic staff to install software on their 'work' machines inhibits experimentation and crucially prevents synchronising and backing-up mobile devices.

Technical staff often have rules about preferred and supported hardware and software systems. These are derived from their work with desktop PCs and are unhelpful if applied uncritically to mobile devices where the market-place is still evolving.

If wireless and mobile learning are to become part of a course, then institutions' quality assurance procedures will ask questions about the comparability and equivalence with other forms of delivery. These are clearly challenging issues for a new pedagogy to address, and wireless and mobile learning needs large-scale trials across institutions and across subjects if its wider potential is to be realised.

Every university and college has a teaching and learning strategy with an e-learning component. This articulates the roles and responsibilities that underpin the strategy and this will usually include high-level learning and teaching 'champions'. It would usually be their responsibility to implement the practicalities of any institutional wireless and mobile learning policy.

One largely unresolved issue for more sustained wireless and mobile learning is the attitudes of students, potential students and teaching staff.

## **6.2 Trends**

The development of wireless and mobile learning in the post-16 sectors will take place in the context of various trends in the wider technical, social and commercial environment. The leisure, retail, business and commercial markets will continue to drive mobile device design, marketing and pricing and educational innovators will have to continue adapting technologies intended for other markets and other purposes.

It will mean that many students, perhaps only the more affluent, will enter further and higher education already owning wireless and mobile devices. Institutions must accept and exploit this diversity of technologies, devices and connectivity, and use their own resources to maintain equity for less affluent students. Community, further and higher education will also see raised expectations amongst younger entrants as wireless and mobile learning become widespread in schools. These factors will mean that institutions must be very flexible and responsive in working with a proliferation of platforms, systems and networks.

In line with social trends there will be increasing but unsupported handheld computer use by academic staff and possibly even greater laptop usage (and home-working), reinforcing concerns about cost issues, the length of the working day, loss of privacy and stress.

Institutions are currently cautious about exploiting wireless and mobile technologies in teaching, learning, assessment and administration and its champions must recognise the issues that this review has raised. These include

- usability
- network security
- diversity and fluidity of devices, platforms and systems
- lack of staff expertise
- procurement, maintenance, ownership

One type of wireless and mobile technology that is different is SMS texting. It is different because institutions unusually do not have to procure or maintain the hardware – mobile

phones are universal - and need only pay for bulk messages. SMS texting presents a unique opportunity for institutions to improve retention, efficiency and contact.

## **7. Conclusions and recommendations**

We are seeing an increasing and informed diversity of learning, teaching and administration taking place on a range of mobile and wireless devices; we can also expect to see a continued improvement in the performance, usability and connectivity of mobile devices and a gradual understanding of the affordances of mobile learning in the wider context of technology supported learning. A good understanding of the unique advantages and disadvantages of wireless and mobile devices is emerging, but claims that are being made need further evidence before generalization. Key issues and problems are beginning to be understood. Research and evaluation in this area often relies on technical proficiency, or alternatively, good collaborative relationships among people with different kinds of expertise.

We conclude with a number of recommendations for institutions, teaching and learning recommendations for practitioners, and recommendations for JISC.

### **7.1 Recommendations for institutions/senior management**

The way forward for an institution will obviously depend on a wide range of local factors, including its students' needs and preferences, its staff's expertise and enthusiasm and the institution's resources and organisation. There are however some tactics that will enhance the success of a mobile and wireless learning policy. They are based on well-established research on technology, innovation, change and higher education, and on experience across a range of institutions:

- Projects will reward and support innovative lecturers, gain and publicise valuable early insights and give wireless and mobile learning positive local visibility.
- Exemplar content, lessons and courses across disciplines will give lecturers a sense of what they themselves could achieve; some of it should be 'quick-and-dirty' and invite imitation.
- High-level 'buy-in', managers seen using wireless and mobile devices, will increase credibility and status of wireless and mobile learning.
- Identification and exploration of potential revenue streams will enhance sustainability; some projects could specifically address this aspect of wireless and mobile learning.
- Recognition that mobile and mobile devices are 'personal' and encourage 'ownership' amongst lecturers – easy access to a range of mobile devices will develop familiarity, expertise and confidence.
- Reliable and robust technical support, infrastructure, network access and hardware will mean that lecturers can innovate – especially in front of 'live' classes - without risk.
- Standards introduced and developed only as experience accumulates, avoiding premature 'lock-in' to specific platforms or systems; the same is true of ways of measuring the progress and success of wireless and mobile learning.
- Sustained, timely and accessible staff development that addresses lecturers' pedagogic and technical worries; mixing 'just-in-case' with 'just-in-time'.
- Credible channels of evaluation, feedback and communication between students, lecturers and management will foster greater 'ownership' of the institutional strategy as it evolves.

### **7.2 Teaching and learning recommendations for practitioners**

Some disciplines will see more immediate opportunities for the use of mobile devices than others. For example, subjects with placements or field study, or which use portfolios of evidence could be quicker to see the potential. From the perspective of current and potential pedagogical uses, we offer the following suggestions to practitioners:

- Consider a repertoire of possibilities for the new technology: its potential to support teaching, learning, and the management of teaching and learning
- Review how wireless and mobile technologies might facilitate contextual learning in your subject, i.e. allowing the information available in a learners' location, and relevant to their needs, to be captured or delivered in context and to contribute to teaching and learning
- Investigate the scope for continuity of learning, i.e. taking advantage of availability of a portable device in an institutional setting, workplace setting and at home, where this can encourage consolidation and increased familiarity with learning material
- Appraise the various communication channels between yourself and your students, e.g. SMS, voice messages, email, online or mobile discussion forum, from a social as well as a pedagogical point of view
- Be cautious about claims that the new technologies can be used "anywhere, anytime": pedagogical, technical, logistical, usability, and social constraints must not be overlooked
- Consider the physical environments in which new technologies will be used, and how this could impact on effective learning
- Make time to understand new student audiences and patterns of study that emerge when learners obtain access to wireless and mobile technologies, including non-traditional entrants
- Exploit the support that mobile devices offer to social networks, communication with mentors and experts, and interaction in online communities
- Explore how mobile and wireless and mobile learning can make for a more immersive experience in your discipline, through increased richness and diversity of both content and activity
- Remain on the lookout for unexpected benefits or learning outcomes, as well as unanticipated disadvantages.

### 7.3 Recommendations for JISC

Finally, it is appropriate to look at recommendations in the short-term specifically for JISC itself:

- JISC should explore the nature of the evidence and the procedures that would influence national funding, regulatory and advisory bodies, and institutional decision-makers to support large-scale trials and evaluations of mobile and wireless learning. This process could perhaps be initiated by
  - Running workshops for senior managers and institutional stakeholders that would look at the strategic issues associated with implementing innovative technologies such as mobile and wireless learning.
  - Exploring ways in which projects could be funded beyond pilot status, in which sustainability issues could be emphasised and in which collaboration with other institutions and funders could facilitate moving pilot projects into the mainstream.
  - Exploring the potential revenue streams and business models that might underpin sustained and large-scale mobile and wireless learning.
- JISC should explore the longer-term likelihood of flat-rate access to national mobile phone networks and hence the possibility of some national body negotiating bulk network access for the education sectors to the networks, in effect 'mobileJANET'.
- JISC should explore the wider availability of software and content for mobile and wireless learning, perhaps working to enlarge the work of CHEST and looking at e-book licensing and availability, and issues of standards, interoperability and reversioning in relation to the currently volatile field of mobile and wireless learning.

- JISC should create an ongoing forum and interface between the educational sectors (individual institutions, procurement agencies, and associations of learning and teaching champions, of IT service departments and learning resource specialists) and the relevant industrial players (networks, content developers, hardware manufacturers, large resellers) so that each has a greater understanding of the needs, directions, constraints, environment and resources of the other.
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# Current Uses of Wireless and Mobile Learning

Lead Author: Agnes Kukulska-Hulme, The Open University

## 1. Introduction

This review addresses current, reasonably established, uses of wireless and mobile technologies in post-16 education. It identifies reasons for using the technologies, main types of uses and their impacts. Benefits for learners and their experiences are examined, as well as issues that arise for both teachers and learners. Finally, we reflect on current practice and promising areas for development.

## 3. Current uses of wireless and mobile technologies in teaching and learning

### 2.1 Reasons for using wireless and mobile technologies

To understand current uses of wireless and mobile technologies, we have to begin by asking what motivates teachers, learners and organisations to make use of these new technologies. The reasons are somewhat related to the choice of actual devices, as 'wireless and mobile' covers a very wide range of possibilities.

In their report on the use of 'palmtop computers' for learning, Savill-Smith and Kent (2003) identified five main reasons for their uptake: the devices are relatively inexpensive, they offer the possibility of ubiquitous (anywhere, anytime) computing, they promote information literacy, help with collaborative learning, and they also support independent learning. Additional reasons include: assisting with students' motivation, helping organisational skills, encouraging a sense of responsibility, acting as reference tools, tracking students' progress, and for assessment.

A range of environmental factors and trends also comes into play. Anderson and Blackwood (2004), who reviewed the use of both mobile phone and PDA (personal digital assistant) technologies in education, identified key factors in the uptake of these technologies as being: (a) the widespread adoption of mobile devices, (b) the changing strategic demands of the educational environment - an increasing emphasis on lifelong learning and widening participation, and (c) developments in pedagogy which have moved towards active learning using constructivist models that emphasize learner autonomy. Specific initiatives can be seen in the context of these trends. For example, in the UK-wide Wireless Outreach Network Initiative 2002-4 (Essom, 2004), the main motivation for using wireless laptops was to widen participation by increasing access to learning for socially and economically disadvantaged adults.

Information about reasons for using wireless and mobile devices is also found in individual published trials and case studies. In the JISC [Case Studies in Wireless and Mobile Learning in the post-16 sector](#) (2005), which included the use of various devices as well as some specially designed or adapted 'learning spaces', a number of different challenges were identified, e.g.

Access:

- To enable nurses to work in geographically dispersed nursing placements and home environments as well as at university

- To take ICT classes to adults who find it hard to attend classes on campus, and to traditionally 'hard to reach' or disadvantaged groups

Changes in teaching and learning:

- To enable students to communicate and share ideas effectively, especially in small group collaboration
- To support differentiation of student learning needs and personalised learning
- To further the use of ICT within the curriculum by direct involvement of students in the data collection process as part of learning 'in the field'
- To enable new developments in formative and summative assessment
- To increase motivation and address low interaction levels in large classes

Alignment with institutional or business aims:

- To respond to rising student demand for access to ICT facilities
- To improve retention and achievement, by improved monitoring of student attendance and by giving immediate and regular feedback to students regarding attendance and progress – teachers were able to do this by having ready access to information on their mobile devices.

Similar concerns, and some additional ones, emerge from an analysis of 12 international case studies in the book on mobile learning by Kukulska-Hulme & Traxler (2005). This shows that reasons for using mobile technologies in teaching and learning again relate principally to improving access, exploring changes in teaching and learning, and alignment with institutional or business aims. Typical reasons include:

Access:

- Improving access to assessment, learning materials and learning resources
- Increasing flexibility of learning for students
- Compliance with special educational needs and disability legislation

Changes in teaching and learning:

- Exploring the potential for collaborative learning, for increasing students' appreciation of their own learning process, and for consolidation of learning
- Guiding students to see a subject differently than they would have done without the use of mobile devices
- Identifying learners' needs for just-in-time knowledge
- Exploring whether the time and task management facilities of mobile devices can help students to manage their studies
- Reducing cultural and communication barriers between staff and students by using channels that students like
- Wanting to know how wireless/mobile technology alters attitudes, patterns of study, and communication activity among students

Alignment with institutional or business aims:

- Making wireless, mobile, interactive learning available to all students without incurring the expense of costly hardware
- Delivering communications, information and training to large numbers of people regardless of their location
- Blending mobile technologies into e-learning infrastructures to improve interactivity and connectivity for the learner
- Harnessing the existing proliferation of mobile phone services and their many users.

## 1.2 Main types of uses

A question that is often posed in relation to the use of new technology in education is whether the technology enables new kinds of learning. Certainly the development of e-learning is



having an impact on teaching and learning practices, and it is reasonable to enquire what difference wireless and mobile technologies can make.

Naismith *et al.* (2004) have demonstrated that mobile technologies can relate to 6 different types of learning, or 'categories of activity', namely behaviourist, constructivist, situated, collaborative, informal/lifelong, and support/coordination. The mobile aspect comes to the fore in the following ways:

- For *behaviourist*-type activity, it is the quick feedback or reinforcement element, facilitated by mobile devices, that is most notable.
- For *constructivist* activity, mobile devices enable immersive experiences such as those provided by mobile investigations or games.
- For *situated* activity, learners can take a mobile device out into an authentic context, or use it while moving around a context-aware environment in a specially equipped location such as a museum.
- For *collaborative* learning, mobile devices provide a handy additional means of communication and a portable means of electronic information sharing.
- For *informal and lifelong* learning, mobile devices accompany users in their everyday experiences and become a convenient source of information or means of communication that assists with learning, or records it on the go for future consultation.
- *Support, or coordination* of learning and resources, can be improved by the availability of mobile technologies at all times for monitoring attendance or progress, checking schedules and dates, reviewing and managing - activities that teachers and learners engage in at numerous times during the day.

This suggests that the new technologies enhance and extend teaching, learning and support activities, and over time we may see them multiply. Context-aware environments (where context-specific information is made available or used by learners as they move around) and immersive activities are opening up possibilities for new kinds of learning experiences. The ongoing nature of mobile collaboration and lifelong learning are creating the potential for the emergence of new attitudes and new outcomes that are only just beginning to be described or named.

Our review of literature and our investigations of wireless and mobile learning also suggest to us that the new technologies are particularly suited to certain kinds of activities or outcomes. As learning design and course design nowadays prioritize learning activities and outcomes, this alternative way of looking at things may be helpful. Wireless and mobile devices appear to be especially suited to:

- Motivating
- Alerting
- Rapid response
- 'Drip,drip' learning - little and often
- Skill building - little by little
- Self-evaluation and reflection
- Collaboration on task - spontaneous and ongoing
- M-mentoring & m-moderating - as developments of e-mentoring and e-moderating
- M-portfolios - electronic portfolios on mobile devices
- Information gathering on the go
- Learning in context - using contextual data
- Connecting workplace learning with institutional learning
- Recording experiences using multiple media - video, audio, text, graphics
- Internet or resource access, almost anywhere and anytime
- Widening participation
- Improving accessibility
- Personal learning management
- Strengthening ownership of learning

Three keywords that seem to sum up the main benefits are: *portability*, *connectivity*, *convenience*. Do these possibilities and benefits imply wider changes in pedagogical practices? We are still at a stage where any changes in pedagogical practice are quite localized. In the next section some observed impacts on teaching, learning and assessment are reviewed.

### 1.3 Impacts on teaching, learning and assessment

Mobile devices are increasingly able to carry media-rich content, and greater interaction with educational materials (e.g. the capacity to bookmark and annotate them on mobile devices) may strengthen a content-driven pedagogical approach. But at the same time, increasing possibilities for students to collect and contribute new content are creating student-generated learning. Basic handheld computer functionality is currently insufficient to support the level and richness of discussion and interaction amongst students that a more student-centred conception of teaching would envisage. Nevertheless collaborative learning is already becoming more common, for example where learners are able to carry around their portable devices in groups and to communicate verbally.

Teachers are now finding themselves in situations where they need to focus more on:

- identifying and catering to students' specific knowledge needs
- fostering reflection on learning processes
- helping with the management of learning
- monitoring performance
- developing new strategies for consolidation of learning and assessment.

According to experience at Strathclyde University ([JISC Case Studies in Wireless and Mobile Learning, 2005](#)), using 'personal response' technology (electronic voting) in lectures lends itself to concept teaching but it can reduce the amount of time available for more straightforward delivery of lecture material. Practitioners have to find time to understand new student attitudes, new audiences and different patterns of study as well as having to grasp the possibilities of the new technologies. Lack of time, and shifts in the ways that time is allocated and used, are recurring issues.

So why would teachers engage with this technology? Benefits that teachers are likely to see include increased student motivation and participation, better retention and achievement. In some situations there will be easier monitoring of performance, and they are likely to see higher interaction levels, which may be most noticeable in collaborative groups and in larger classes. Communication channels between staff and students, and among students, are becoming more complex but also offer a more flexible range of options, e.g. email, SMS, voice messages, online or mobile discussion forum.

Early evidence (Plant, 2001), especially in relation to handheld computers and mobile phones, suggested that learners and users regard handheld devices as far more 'personal' than static or desktop computers. This means that mobile learning is also *personal learning*, which could be remote and individual, or social and collaborative. Those learners who have access to mobile and wireless technologies have an additional means of communication and are able to share information with others. However, currently only mobile phones are owned by large proportions of learners. *Personal learning* is also at the heart of three scenarios described by de Freitas and Levene (2003) in their report on mobile and wearable devices in further and higher education institutions: web lectures delivered on handheld devices, a campus without walls, and enhanced field trips such as museum visits and wildlife projects.

In an era when education is increasingly multicultural, global and widely accessed, we need to remember that the experience of educators working with non-traditional university entrants, with overseas course participants and working outside Europe, North America and Australasia – will often be very different. Traxler and Kukulska-Hulme (2005) have addressed mobile learning with a view to how developing countries could use it, but other perspectives are more implicit: a Western view might be contrasted with developments in the Far East, for

instance. Summarizing lessons that had been learnt from the Mobilelearn project at the CAL 2005 conference, Sharples (Vavoula et al., 2005) emphasized that they represent a “very European” perspective, because of the nature of this project and the partners who were involved in it. The key realisations emerging from the project were as follows:

- It's the learner that's mobile
- How learning is interwoven with everyday life
- Mobile learning can both complement and conflict with formal education
- Context is constructed by learners through interaction
- Ethical issues: privacy, ownership

## **2. Current benefits for learners**

### **2.1 Examining the evidence**

The field of mobile and wireless learning is at present characterised by a proliferation of pilots and trials that allow the technologies to be tested out in a variety of learning contexts. The sustained deployment of mobile learning will depend on the quality of these pilots and trials, which includes evaluation methodology and reporting. What evidence is there of any benefits derived from the use of these new technologies? How is evaluation being done?

Evaluations typically include questionnaires, interviews, discussions or focus groups. A few studies use specific technologies to capture student reactions or to monitor usage. The following are some examples from studies undertaken since 2002 (the references are to chapters in: Kukulska-Hulme & Traxler, 2005):

- Feedback from students obtained at several stages, using informal and formal methods - feedback via telephone, a snap poll in class, a questionnaire, a focus group (Levy & Kennedy)
- Automatic logging system that records when a PDA is used, which applications are used, when beaming occurs; this enables a quantitative analysis of student learning patterns (Trinder *et al.*)
- Field-based interviews, observations and walk-throughs, plus experimental interventions (Smordal)
- Questionnaires, discussions, logging data and an on-line poll (Luckin *et al.*)
- Questionnaires, focus groups, logbooks (recording uses, activities, time spent, tools used) (Sharples *et al.*)

Problems collecting desired data are also sometimes reported in these studies, e.g. students failing to return questionnaires (Trinder *et al.*) or software issues preventing transmission of monitoring data (Kneebone & Brenton).

There is no agreed method and there are no widely used novel tools for collecting evaluation data. With the exception of cutting edge research projects, data collection largely relies on established methods in educational research and some exploitation of new technology. The latter requires skills that are being developed by researchers but that most teachers would not currently have at their disposal when evaluating their practice. It is also important to be cautious about generalizations being made at this early stage of use of the new technologies. For example, it is often claimed that mobile devices can be used ‘anytime, anywhere’. Although claims like this may be supported with more evidence in the long run, it is important to bear in mind the relatively small amount of evidence we can draw on currently.

### **2.2 Learners' experiences and outcomes**

The studies undertaken in the [JISC Case Studies in Wireless and Mobile learning project](#) (2005) identified a number of benefits to learners, including the following:

- Working at a learner's own pace (Dewsbury College of Further and Higher Education)
- A record of learning progress, and a sense of making progress in lectures (University of Birmingham, University of Strathclyde)
- An improved understanding of subject matter (University of Strathclyde)
- Immediate and regular feedback (Ealing, Hammersmith and West London College)
- Increased engagement and motivation (Thomas Danby College, Bishop Burton College, University of Strathclyde)
- A better fit with collaborative and group work tasks (Northumbria University, University of Birmingham)
- Development of communication and reflective skills (eVIVA)
- Access and ICT skills development for off-campus communities (Gloscat)
- Outreach to learners who would not normally have access (NEARIS)
- A more comfortable environment and more personal space on a desk, compared with desktop PCs (Northumbria University, Ealing, Hammersmith and West London College)

Clearly, these benefits are derived from the use of particular technologies in particular contexts, however the list does represent commonly reported benefits of current uses.

In the same case studies, outcomes for learners were often discussed in terms of:

- The development of reflective skills, discussion skills, oral skills, social skills, peer review, independent learning, ICT skills.
- Students being able to keep in contact with a peer group whilst on work placements.
- Learners' perceptions that they became more efficient and productive learners.
- Support for evidence gathering, where a 'lifelong learning' approach was anticipated.
- The variety of media and self-pacing attributes encouraging students to engage with learning material.
- Continuity of content - availability in college and at home - encouraging further consolidation and familiarity.
- The portability of the media allowing learners to borrow a PDA in order to complete missed work.
- The use of mobile technology serving as a great motivator.

Teachers who are innovators and early adopters of the new technologies usually have a good sense of why they have chosen to use them and what benefits they can bring - and they communicate this well to their students. They are also shrewd observers of unexpected benefits and outcomes. There is much to be learnt from current good practice. In the next section we also review typical problems that are encountered.

### **3. Reflecting on current practice**

#### **3.1 Issues noted in reviewing current uses**

Provided that equipment is working reliably, learners appear to respond well to the new technologies. However, set against the benefits are a number of issues that are being reported. Top of the list in case studies are current technical limitations such as battery life, which require educational activities to be adapted to new constraints. Practitioners are asking themselves whether the new devices are suitable for all learning styles and the extent to which this may affect take-up. The impacts on learning spaces are beginning to be addressed.

Collective experience to date indicates a number of potential pitfalls in using wireless and mobile technologies for teaching and learning:

- Lack of success may be due to inappropriate use for a given pedagogical context
- Material transferred to a mobile environment may need redesign
- Technology may cause more problems than it solves

- Loaned devices lose the benefits of personalization
- Inadequate usability may lead to rejection.

It is also sometimes noted that educational practices are being affected in a number of ways:

- There is now a broader range of where learning takes place
- Increasing emphasis on filling small gaps of time
- The realization that it takes time for new patterns of use to evolve
- The realization that lecturers need to become 'device-aware', i.e. to understand the potential, the features and limitations of wireless and mobile devices.

Naismith *et al.* (2004) have identified a number of additional issues:

- Gathering and using contextual information based on a learner's location and activity may clash with the learner's wish for anonymity and privacy
- Students may abandon their use of certain technologies if they perceive their social networks to be under attack
- Mobile activities – i.e. outside the classroom - may not correspond with either the teacher's agenda or the curriculum
- Students want to own and control their personal technology, but this presents a challenge when they bring it in to the classroom
- Effective tools are needed for the recording, organisation and retrieval of mobile learning experiences.

### 3.2 Promising areas for development

When we consider recent publications on mobile and wireless learning, they fall into two main categories: (a) overview reports that offer an orientation in the field and some advice; (b) collections of research papers in journals or conference proceedings. The latter offer us a good insight into aspects that are the focus of topical discussion and investigation. An analysis of papers at the 3<sup>rd</sup> annual Mlearn international conference in 2004 shows that the mobile learning research community is reflecting on the following aspects of practice:

- Collaboration and community, e.g.
  - Mobile computer and mobile phone supported collaborative and informal learning
  - Seamless access to shared web sessions from multiple devices
  - Interactivity in large classes using wireless devices
  - Assessment of learners in collaborative mobile learning
- Content for mobile learning, e.g.
  - Capturing case studies in workplace contexts
  - Game-based learning on mobile phones
  - Messaging technologies in support of retention and for language learning
  - Converting e-learning content to m-learning
  - Learning objects on mobile devices
  - Content adapted to user's location
- Technical innovations, e.g.
  - Using digitally augmented paper and mobile devices to bridge use of paper and hypermedia
  - Wireless Learning Management Systems
  - Seamless integration of tools for learning, collaboration and time management
  - 'Team awareness' features to enhance learning in context
- Reaching new kinds of learners, e.g.
  - M-learning for the underprivileged

- Addressing poor literacy and numeracy skills by using mobile devices
- A hospital information system accessible through mobile devices
- Mobile first aid and emergency management
- Understanding the field of mobile learning, e.g.
  - Ethical and legal challenges in mobile learning
  - Use of scenarios to understand user requirements

In considering the landscape of 'current uses' of wireless and mobile technologies in post-16 education, it has been difficult to draw a boundary around 'established' uses in ways that would distinguish them from the realm of leading edge of research. We can say that current practice world-wide is characterised by mostly small scale trials and some campus-wide initiatives. We are still seeing mainly localized impact on teaching and learning practice. A good understanding of the unique advantages of wireless and mobile devices is emerging, but claims that are being made need further evidence before generalization. The key issues and problems are beginning to be understood.

Wireless and mobile technologies are not normally used in isolation to support learning. They are part of a range of technologies and methods. Finding the factors that determine the most appropriate mix of methods and technologies in any given circumstances is a high priority issue for the next generation of mobile learning researchers and developers.

Research and evaluation in this area often relies on technical proficiency, or alternatively, good collaborative relationships among people with different kinds of expertise - coupled with a good deal of courage!

## 4. Recommendations

Based on the experience of the current generation of practitioners who have embraced wireless and mobile technologies, we offer the following suggestions:

- Consider a repertoire of possibilities for a new technology: its potential to support teaching, learning, and the management of teaching and learning
- Review how wireless and mobile technologies might facilitate contextual learning in your subject, i.e. allowing the information available in a learners' location, and relevant to their needs, to be captured or delivered in context and to contribute to teaching and learning
- Investigate the scope for continuity of learning, i.e. taking advantage of availability of a portable device in an institutional setting, workplace setting and at home, where this can encourage consolidation and increased familiarity with learning material
- Appraise the various communication channels between yourself and your students, e.g. SMS, voice messages, email, online or mobile discussion forum, from a social as well as a pedagogical point of view
- Be cautious about claims that the new technologies can be used "anywhere, anytime": pedagogical, technical, logistical, usability, and social constraints must not be overlooked
- Consider the physical environments in which new technologies will be used, and how this could impact on effective learning
- Remain on the lookout for unexpected benefits or learning outcomes, as well as unanticipated disadvantages
- Make time to understand new student audiences and patterns of study that emerge when learners obtain access to wireless and mobile technologies, including non-traditional entrants.

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# Potential Uses of Wireless and Mobile Learning

Lead Author: Diane Evans, The Open University

## 1. Introduction

This review addresses potential uses of wireless and mobile technologies and identifies some recent technical developments. It considers how their use might be developed within existing learning and teaching paradigms and it identifies some new models for learning which have been proposed recently.

## 2. Future needs and opportunities in post-16 education in learning and teaching

Learning post-16 covers a wide spectrum and to understand the potential uses we begin by considering some of the main challenges for both formal education and lifelong learning. The same or similar challenges and possible solutions feature in several areas and are expanded as they occur.

### 2.1 Further Education

Reform of the 14-19 curriculum will enable some students to follow an apprenticeship by including workplace training as part of their courses. Other time will be spent in school or college studying foundation and core subjects. This will result in some learners moving between school, workplace and home. Technology can play a part in helping them to:

- access learning records
- register attendance
- download learning materials
- keep in touch with subject and specialist teachers / tutors
- be part of a learning community.

The changes suggest that shorter courses with more bite-sized material will be needed to enable the flexibility to support multiple personalised routes of learning. Furthermore content needs to engage young learners many of whom are used to rich multimedia applications through using PlayStations and online interactive games.

Given the likelihood of learners' mobility between different locations of study, there is the potential for mobile devices to play a key part in supporting them at this stage. Handheld devices are already in use by this age group on a regular basis as part of their social environment. The communication functionalities offered by differing mobile devices is converging as is evidenced by developments in both mobile phones and personal digital assistants (PDAs).

Bite-sized material can be rendered for delivery through mobile devices which also offer possibilities for multimedia delivery and interaction.

It is suggested that



*“ ... it would be beneficial to both learner and teacher to be able to record and demonstrate progress throughout the learning experience and that this could be achieved by creating*

- *a learner's e-portfolio and*
- *through a variety of e-assessments.”*

[14-19 White Paper summary (Black, 2005)]

Teachers will need to keep track of the students' progress across these different environs and, where necessary, support and motivate individuals. Changing the nature of assessment to focus on the development of the learner throughout the learning process is suited both to problem-based learning and collaborative activities. These types of learning offer opportunities to foster peer moderation networks and online communities. With mobile devices students would be able to participate in such activities wherever they are based. Additionally there is the possibility to embed electronic assessment into resources in ways that could assist the learner to monitor their own progress.

Mobile and wireless technology offers new ways to approach both assessment and the creation of portfolios. They could provide both synchronous and asynchronous

- communication with peers and teachers
- collaborative features enabling the sharing of material
- the facility to access resources, including online communities from local and world-wide repositories via the internet
- delivery of multimedia content.

## **2.2 Higher Education**

Government initiatives on widening participation in HE are likely to extend the need for more flexible delivery and study of courses to satisfy the needs of this wider audience. The UK Open University, which has been providing distance education for many years, is increasing its use of online collaborative activity and content; although this is not yet rendered for delivery on mobile devices, students are beginning to use course materials in e-book form on their own mobile devices. Many universities use an online Learning Management System (LMS) to present electronic content and control aspects of course management relating to assessments and organisation etc.

Some countries, where there is not an established wired communication network, are investigating the potential of mobile phones and wireless PDAs to support learning and teaching in remote areas.

Most students now enrol with some prior experience using technology in learning and are likely to expect this to continue with their new studies. As with the use of ICT in general there is likely to be a trickle-down/trickle-out effect with mobile technology, e.g. schools-based mobile learning into FE, Adult and Community Learning, and into HE.

Many students need to carry out their studies in parallel with some form of paid employment and may seek to engage with their studies in a way that is more flexible in terms of time and place.

Traditional campus based education often reaps the benefits of the proximity of groups of learners. These groups often generate self-help groups, opportunities for informal discussion, and support prescribed group work. This discourse helps to develop and consolidate knowledge. Social learning could be enabled by technology that supports both synchronous and asynchronous communication and collaboration.

## 2.3 Life-long learning

The DfES *Five Year Strategy for Children and Learners* document, published in July 2004, stated:

*'Lifelong learning is at the heart of our agenda. By this we mean learning across the whole of life – not just post-19 or post-16 learning, but the development of learning communities from the cradle to the grave. Skills and learning are not just about economic goals. They are also about the pleasure of learning for its own sake, the dignity of self-improvement and the achievement of personal potential.'*

The subsequent e-learning strategy document – *Harnessing Technology: Transforming Learning and Children's Services* (March 2005) details the way ICT and electronic learning technology, in the form of personal on-line learning spaces and e-portfolios, could support continuing learning. The objective is for these to be accessed, developed and used throughout education, the workplace and lifelong learning:

*'Lifelong Learning Networks will eventually allow learners to advance their skills as they move between further and higher education and the workplace.'*

Lifelong Learning UK is the Sector Skills Council for the post-16 training and education sector workforce.

There seem to be three motivations for learning in the non-formal learning phases of life:

1. Maintaining employment in a job market where there is no longer a 'job for life'. This often involves skills acquisition and development and may occur within a company as part of its employee Career Development Strategy or be undertaken by individuals outside their work environment.
2. On-the-job learning within the business organisation undertaken by individuals as part of their job. Much of this learning is Informal Learning. Cross (2003) states that Informal Learning accounts for 80% of all learning. Control and responsibility for this learning lies with the individual learner. Learning takes place through a diverse range of activities:
  - Observing colleagues
  - Asking individuals
  - Calling help-lines
  - Trial and error
  - Working with others in teams.
3. Learning for pleasure or interest. This may be stimulated by a leisure interest or pursuit e.g. painting or a visit to a museum or art gallery etc. It may be accomplished by individual research, communication in groups with a common interest, or by attending short courses.

The expansion of courses leading to Certificates of Higher Education offered by the University of Leicester, among others, under the umbrella of Lifelong Learning, bears witness to the investment universities are making in this area. The ability to study in a flexible way offers benefit to learners who study alongside work and family commitments. The development of the University of the Third Age offers learning activities directed at older learners.

A common feature of these types of learning is that it is often delivered in small pieces and often requires supplementary activity by the learner:

- Someone learning a foreign language would benefit from listening to the language being spoken, reading and writing text, and conversing with others. All of these would be possible with a single mobile device.
- An employee away on a business trip may need to access up-to-date information from another part of his organisation to prepare an ad hoc presentation that pulls together knowledge from different parts of the organisation. With a mobile device, she/he can readily access information, making time differences irrelevant. Wireless and mobile technology would also allow conversations and communications about the presentation with people from the home site.
- An art student could record digital photographic images while out on a ramble together with additional textual information, and possibly include a link to an online map reference. This could then be accessed later to provide a basis of a study.

## 2.4 E-assessment and e-portfolios

The prefix 'e' denotes an electronic format. There are many different forms of electronic assessment. For example it could be completed online as questions and selected answers with immediate feedback, or as an electronically produced assignment, submitted as an attachment to an email, which is marked on the computer before being returned to the student as a second email attachment. Other assessments can make use of specially created software that marks long textual answers by searching for pre-determined criteria.

Brown and Voltz (2005) identify the need for provision of feedback that will 'amplify the learning from the experience and also enable students to increase their skill level and knowledge' as one of six elements of effective e-learning design. This is a challenge for subjects like performing arts, and those where counselling and interviewing play a key part.

Portfolios have been a feature of many courses in secondary education, and indeed for art students and artists at any level. An e-portfolio is one where the documentary evidence is stored as an electronic file. Possibilities include graphics, audio, video and text.

LaCour (2005) states that

*'...today learners are using e-Portfolios at institutions to store and present evidentiary files documenting their educational and professional growth .... Learners are also using ePortfolios as evidence of competency when applying to graduate school or seeking employment.'*

The e-Portfolio can be used as a repository for collecting and evaluating learning outcomes. They can be centrally hosted but accessed externally so they can be portable; thus learners can continue to build and make use of their portfolios outside institutional boundaries. The online portfolio can be made available to prospective employers or others who are sent the appropriate hyperlink by the owner.

In a recent White Paper on researching electronic portfolios and learner engagement, Barrett (2005) explores the multiple purposes for their use. She also looks at motivation and student engagement in the process and considers the use of portfolios in supporting assessment. She concludes by stating that the time is right to

*'...study the potential of electronic portfolios to engage students in active participation in assessing and managing their own learning'.*

Technology is becoming more integrated in both the learning and assessment activities of students at all stages.

### **2.4.1 Mobile and wireless technologies as a factor in e-assessment and e-portfolios**

Wireless offers the facility to

- access local networks and the internet across a wider physical area and using a more diverse set of devices
- obtain instant feedback in response to a question e.g. via multiple choice answers in a lecture / seminar session which is not hardwired for access
- access, receive and send information to others, including teachers.

Wireless connectivity, together with mobile devices, can

- support and monitor student learning activity in areas away from the traditional classroom in real time
- support and monitor collaborative group work as part of such activity
- offer the facility to analyze and enhance project work by recording and replaying audio.

Mobile devices could support and facilitate communications related to e-assessment wherever the student may be located:

- Text messaging to remind a cohort of students of imminent submission date
- Text messaging to remind an individual of possibilities if deadline is past.
- To submit an assessment as an attachment to an e-mail or MMS message
- New features of mobile devices can be used as alternatives to generate content for assessment (e.g. camera phones – images to illustrate work)
- During field studies inbuilt recording, sound and video, can capture the moment for later development or ongoing skills assessment.

Opportunities exist to use mobile devices, perhaps together with other digital devices, to demonstrate, capture and record the evidence of skill competencies within courses with high practical bias and/or placement activity. For example with construction or catering courses, a student could create a video record of themselves working, or digital photographs at stages of development.

As the features offered by mobile devices continue to develop, the potential will be there for teachers to envisage new uses.

## **2.5 The European view**

The following highlights taken from the European Union's aims for 2010 (Oliveira, 2003) were cited by Brown (2004) and presented during his keynote speech at the MLEARN 2004 conference:

- We should experience a shift from PC centeredness to ambient intelligence. The ICT environment should become personalised for all users. The surrounding environment should be the interface and technology should be almost invisible. There should be infinite bandwidth and full multimedia, with an almost 100% online community.
- Innovations in learning that we should expect are focused on personalised and adaptive learning, dynamic mentoring systems and integrating experienced based learning into the classroom. Research should be done on new methods and new approaches to learning with ICT.
- Learning resources should be digital and adaptable to individual needs and preferences. E-learning platforms should support collaborative learning. There should be a shift from courseware to performance-ware focused on professional learning for work.

- ICT should not be an add-on but an integrated part of the learning process. Access to mobile learning should be enhanced through mobile interfaces.

### 3 What new models of learning are being promoted?

It is not being suggested that previous learning paradigms are obsolete. Mobile devices will support a range of teaching and learning approaches. There continues to be a role for behaviourism and constructivism in many of the different approaches that we adopt during the learning process. However, over time the focus of the activities promoted by each approach has shifted, e.g.:

- From constructivism to socio constructivism
- From knowledge production to knowledge configuration

#### 3.1 Social constructivism and mobile learning

Social constructivism is an alternative approach to the content approach and is based on communication. Learning is seen as the result of active participation in a 'community' where new meanings are co-constructed by the learner and his / her 'community'. This communication approach favours learning technologies which support communication between communities of learners. These may not be exclusively mobile as communication activities can be enabled through both wired and unwired networks.

When there is a requirement to support scenarios where the mobility of learners enters the equation then the benefits of mobile devices begin to emerge. As already mentioned, mobile devices offer advantages in supporting ad hoc communications from variable locations coupled with portability. They offer mobile learners opportunities to interact and to communicate with their peers when they are not co-located.

One example might be an organised field trip where not all students are able to actively participate at the venue, so remaining at base. These latter are able to view the field environment, via digital images or video, and converse with those who are present, interrogating and even directing specific activity using mobile devices.

### 4 Future learning requirements and paradigms

Two new models of learning paradigms have been identified during this study: 'navigationism' and 'connectivism'.

#### 4.1 Navigationism

The rapid expansion of available information makes it unrealistic to expect a university course or individual teacher to present a student with all the information that they will need throughout their working lives. It is also likely that some presented information will be surpassed in a comparatively short space of time.

Tom Brown (2005) proposes a new learning paradigm where the emphasis is on knowledge navigation:

*‘Knowledge navigation is the central issue of what teaching and learning is about - thus the focus of learning is on ‘navigating’ in the ocean of available knowledge.’*

Successful learning takes place when learners are able to solve contextual real life problems by actively engaging in problem solving activities within a collaborative framework. To enable

this, learners need to work together to explore, evaluate, manipulate, integrating and navigate available information.

Mobile and wireless technologies can support navigationism in the following ways:

- Providing 24/7 access to information and stored knowledge within a mobile context. The information may be stored on institutional repositories or accessed via the Web.
- Supporting communication and collaboration activities both synchronously and asynchronously.
- Supporting the acquisition and sharing of evidence in multiple environments for decision making. This would be particularly beneficial when the student's location is out in the field.
- Supporting a teacher in a mentoring role.
- Supporting the teacher in the construction and deployment of blogs and wikis which can encourage development of the information navigation skills often required in business.

## 4.2 Connectivism

In a similar way George Siemens considers the challenges faced by many corporations in knowledge management activities and proposes a new learning theory relevant to learning in a networked world. He presents a view of learning through Connectivism:

*'Connectivism is driven by the understanding that decisions are based on rapidly altering foundations. New information is continually being acquired. The ability to draw distinctions between important and unimportant information is vital. The ability to recognize when new information alters the landscape based on decisions made yesterday is also critical'*

(Siemens, 2004)

Key components of connectivism are social networks and within these are key people who are well connected and can foster and maintain the knowledge flow.

This has much in common both with aspects of informal learning already identified and with the skills developed in the proposed navigational paradigm. Put simply the learner needs to know where or from whom information can be obtained, to be able to both evaluate and apply the information, and to be able to do this within a collaborative framework.

Where do mobile devices come into this? Mobile devices offer support to social networks. They support both synchronous and asynchronous communication with chosen individual experts. With wireless technology they can interact with online communities. Their software supports the maintenance of contact information for both individual and group.

## 5 Future developments targeted by existing research projects

### 5.1 Research projects

During the past two to three years there have been several funded projects involving the use of mobile devices. A large number of both national and international projects are studying their use in a wide variety of contexts. These are just a few.

- The Mobile Bristol project created a publicly-accessible wireless infrastructure covering the city centre. It focussed on enhancing the experience of Bristol as a place to live or visit. It established Node Explore, a service that provides location-based multimedia content to tourism firms. Visitors on boat tours of the harbour were each provided with PDAs which used the boat's position to display relevant multimedia content.
- Tate Gallery – held PDA trials delivering multimedia content linked to the exhibits. This work is continuing with a new tour introduced in spring 2005.
- The University of Birmingham with Nottingham Castle Museum Gallery. Based on ultrasonic location, visitors are offered automatic multimedia presentations on individual PDAs as they walk round the gallery.
- Mobilelearn –explored the use of mobile devices in three scenario settings. Visitors to the Uffizi gallery; MBA students working collaboratively on a case study, on the job training for First Aid workers.
- WearIT@work is a project investigating “wearable computing”. This includes the use of head-worn display screens which enable information to be seen at the same time as the user's hands are actively engaged in a manual task. For example a trainee mechanic working on an engine could view the relevant pages in the manual on the display screen.
- The Urban Tapestries project studied public authoring in the Wireless City. People are able to author their own virtual annotations of the city, adding their own comments and memories using PDAs and mobile phones to access locations and location based content.

### 5.1.1 Content

Mobile learning has several other associated areas of study and research:

- Personalised content based on a learner profile
- Location-based content delivery. Content is presented to the user when they approach a specific location.
- Device aware content delivery. Content is adapted for display on mobile phones, PDAs and laptops or TabletPCs.

Mobile experiences such as those offered in the Mobile Bristol project hint at multimedia experiences enriching the learner experience and immersing them in the experience.

## 5.2 Practice in schools

As previously suggested, student experience with mobile devices in schools is likely to have an impact on their expectations for similar use in post-16 education. Currently a range of devices is being used from mobile phones and PDAs to laptops and Tablets.

Case study reports on their use highlight:

- motivational benefits to both teachers and students
- increased opportunities for students to research by accessing electronic resources
- potential to enhance learning, including the development of cross-curricular activities

- possibility to extend the physical space of the classroom into other areas while maintaining access to online resources through the availability of wireless networks.

Not all these benefits may be directly attributable to the devices themselves. The feedback may be due to the novelty of the device, the different learning experience or a combination of other factors. The use of mobile devices in education is still comparatively new, often less than a year, so it is not known how sustained these benefits will be over longer periods of time.

However, if teachers continue to develop the use of mobile devices in ways which not only enhance but also transform the learning experience then, as students move on from compulsory education, they may have greater expectations of their future learning experience.

## **5.3 Gaming**

### **5.3.1 Commercial developments**

A new feature of PlayStation2 uses a webcam called "EyeToy" which enables children to see themselves inside the game and to control the events of the game from there. They therefore become more active participants. Given appropriate software then one can imagine its use in education. For example within the fields of earth sciences, where by using a video stream which can be controlled by the student they can see themselves 'walking' around in different environments, examining artefacts, hearing the sounds and maybe even smelling the smells.

### **5.3.2 Research in gaming**

A research project at the Future Applications Lab, Viktoria Institute, Sweden studied collaborative games for handheld computers. The games were developed as a student assignment and handed out on PDAs to high school students in a local café. The play area in the game was distributed across several screens and the players had to move their in-game character to other displays to succeed. This required players to collaborate with each other to manage the sharing of the displays. The study indicated a potential for a new interaction model using shared displays as in the games.

Savannah (Facer *et al.*, 2004) is a mobile gaming and learning project used with primary school children. There are two related areas of activity. The first is undertaken outside on the school playing field where the children play the roles in a pride of lions. They are given PDAs (with headphones) linked to a global positioning system (GPS) and through these they can 'see', 'hear' and 'smell' the world of the Savannah as they move around their field hunting for food. The second activity area is an indoor space with an interactive whiteboard displaying a map of the Savannah which can be overlaid with details sent by the children from the field. This area is used to reflect on their performance and develop strategies for surviving as lions in the virtual Savannah.

## **5.4 Technology developments**

The available memory in mobile devices is increasing. Devices are therefore capable of running more complex software or performing more complex tasks. Improved voice and handwriting recognition facilities offer alternative input methods. Speech synthesis converts text to speech, supporting users with a requirement for audio delivery. Integral cameras and voice recorders support alternative data capture.



The website 'Microsoft Watch' (<http://www.microsoft-watch.com/>) has recently reported the next generation of Tablet PC which it said is a form of mini-tablet. It suggests that the education market could be one of the most promising for Tablet PCs.

### 5.4.1 Multimedia

Tony Gore (2005), editor of K2 (the newsletter and webspace created to support projects in the mlearning project), identified some future possibilities which may be opened up by MPEG4 which behaves differently from MPEG2, the video being mixed at the receiving end. It may soon be supported by PDAs and mobile phones. He suggests:

*"An example of use could be "video karaoke" - each band member is a separate video and audio stream (they either have to be filmed against a blue screen background or extracted from the background electronically - this is why it has not taken off yet). Then, putting yourself up against a blue screen background with a camera, you can insert yourself into the video. Thus you could choose to play any part you like. Another proposed use was for video conferencing - in a virtual meeting you could select which people you wanted to see and hear."*

### 5.4.2 WiMax

WiMAX is a standards-based wireless technology that provides high-throughput broadband connections over long distances. This is based on a mesh structure and would enable communications beyond the physical building constraints encountered with WiFi. As WiMAX becomes more widely available it could offer opportunities for educational use with groups interacting wirelessly within a much broader virtual classroom.

Latest versions of multimedia format (MPEG4) and wireless networks (WiMAX) have not yet filtered through to handheld mobile devices and the education environment. It is likely that they will be picked up for exploration in future projects.

## 6 What are the mobile/wireless uses with the most potential for learners?

At a recent Think-tank Day for the UK mobile learning community, organised through this project (April 2005), several specific features of mobile devices were identified which could add benefits to the learning experience:

- Privacy; because of the size of mobile devices, it is possible to learn 'unobtrusively' as an individual wherever you are located.
- Support for learning styles; the features offered by the device have the potential to support learners with preferences for textual, audio and visual presentation of material.
- Immersive; the possible richness and diversity of both content and activity can immerse the student in the experience.
- Capture of data; at a physical location which can be taken away and analyzed later.
- Context; within a context being able automatically to receive relevant information
- User control; students have more control over where and when they chose to study, and over their interaction with other students. It is possible to store content on the device and travel around using it at opportune times.

### 6.1 Visions and opportunity

To benefit from the use of mobile and wireless technologies, teachers, and learners, need to

- adapt and use technology to optimise learning
- focus on the innovative / transformative use of technology
- perceive value in their use
- rethink the discipline to take advantage of the technology
- think about data depth, to provide content which will lock the learner into the subject.

It may be that some disciplines will see more immediate opportunities for the use of mobile devices. Subjects with placements or field study or which use portfolios of evidence could be quicker to see the potential. The potential is there to extend role-play in games which encompass creative collaboration in a mobile situation.

There are potential drawbacks in the future technical advancements of the mobile devices and their suitability for educational use. These devices were, and still largely are, developed for use by the business community rather than education. Practitioner involvement should inform the developments of mobile devices and the applications and technology being developed to run on them. They need to become involved in specifying requirements which will enable mobile use and, in particular, communication and collaboration to play their part in any new teaching and new learning paradigms.

It is likely that over a period of time new pedagogies for teaching and learning with mobile devices will emerge. These may be defined by different subject disciplines or by best practice. It is likely that, in the main, a whole course will not be presented using mobile devices, however, usage as part of a blended approach would seem to be feasible.

Whichever teaching and learning approaches are followed, practitioners need to consider the following:

- Is technology driving learning or are we adapting and using technology to optimise learning?
- Are we slapping new technological tools onto old teaching methods or are we focusing on the innovative / transformative use of technology in new teaching and new learning paradigms?

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# Strategic Aspects of Wireless and Mobile Learning

Lead Author: John Traxler, University Of Wolverhampton

## 1. Introduction

In looking at the strategic aspects of wireless and mobile learning, we move to perspectives governed by concerns rather different from those of technology, learning and teaching. These are in many senses the context and the environment for the technical and the pedagogic aspects. They include:

*Resources:* meaning obviously finance and money but also human resources, physical estates, intellectual property and expertise.

*Culture:* meaning institutions as social organisations, their practices, values and procedures, but also their culture, that is the norms, expectations and standards of their staff, students and their wider communities, local, national and virtual.

In looking at these wider aspects of wireless and mobile learning, it is easy to start addressing far wider – too wide - questions of the processes of organisational change within post-compulsory education. To avoid this we should bear two questions in mind: does technology-based change in education differ from any other organisational change? And, does wireless and mobile-based change in education differ from other technology-based change?

*Literature:* there is a considerable and highly relevant literature around the issues of 'the diffusion of innovations' especially technological ones within organisations (starting from Rogers' seminal work, 1962), and of 'Academics Response to Change' (e.g. Trowler, 1998 and then, Knight & Trowler, 2001), some identified in the References and Resources section. Any attempt to understand, implement or change wireless and mobile learning within further, higher and community education must address the influence of technical and pedagogic concerns and also social, cultural and organisational factors. These can be formal and explicit or informal and tacit and can vary enormously across and within institutions.

## 2. Strategic Overview – Some Themes

In the course of looking at the strategic aspects of wireless and mobile learning, several themes have emerged. Institutions hoping to enhance and support learning with wireless and mobile technologies will need to recognise the significance of these and a number are identified below.

### Projects

Projects, in this sense, are fixed-term and small-scale, with access to specific funds, expertise and enthusiasm. Projects usually refine or answer specific research questions, demonstrate specific technological or pedagogic possibilities and generate academic output.

Current projects in wireless and mobile learning are mainly 'first-generation', meaning that their focus is frequently on making the various technologies work, ensuring learning happens and satisfying funding conditions. These projects do not usually address issues of scale, embedding or quality, and technical challenges often squeeze the time and resource available for evaluation. Consequently identifying explicit and objective improvements or costs can be problematic.

In these projects, wireless and mobile learning are usually implemented as enhancements or extras to core provision, often as a variation of conventional e-learning rather than as a new form of pedagogy. The most exciting, innovative and convincing examples of wireless and mobile learning are projects where new forms of learning are created, rather than where existing forms of learning are reversioned and ported, but these are most problematic in terms of institutions being able to guarantee the standard and quality of learning for their students.

Projects can sometimes form part of an institution's 'project economy' where researchers move on, and developments are not consolidated but they are nevertheless a useful way for institutions to gain experience of wireless and mobile learning. Information on projects can best be found in the relevant conference proceedings (e.g. Attewell & Savill-Smith, 2004).

## **Niches**

Niches, in this context, are small-scale but sustainable initiatives, sometimes growing out of successful projects, based around a limited number of specific funding models. These models include:

- Specific subjects, for example, nursing, teaching practice, or medicine, where funding comes via training/professional agencies. Here wireless and mobile learning has self-evident virtues in enhancing effectiveness and efficiency, by delivering content and sustaining communications where these would otherwise be difficult or impossible.
- Specific pedagogies, for example, fieldwork, field trips, outdoor pursuits, work-based learning, based around the ideas of situated or authentic learning, and for example, reflective logs, self-evaluation, e-portfolios based on the personal, immediate and accessible nature of mobile devices.
- Particular constituencies of learners who are prioritised and/or resourced, for example:
  - the Equal Opportunities, Assistivity, or Widening Participation constituencies where public funds support an inclusion agenda
  - full-cost courses, for example MBAs, where institutions use wireless and mobile learning to add value to their courses and compete with other institutions in the market-place.

In the context of the current UK resourcing and structuring of further, higher and community education, there is unlikely to be general and over-arching support for institution-wide wireless and mobile learning. However, an understanding of the possibilities for sustainable wireless and mobile learning may allow institutions to support specific learners and specific learning in a sensible and effective fashion.

## **Producers, Manufacturers and Developers**

The wider technical and commercial worlds of wireless and mobile technologies are important because they have considerable influence on the effective and increased deployment of wireless and mobile learning. The champions and managers of wireless and mobile learning within further and higher education must be alert for trends and developments.

Many hardware manufacturers see their mainstream wireless and mobile markets as technology-driven, highly segmented and very volatile, whilst seeing the further and higher education markets as fragmented and opaque, working to timescales, budgets and priorities unlike those of any retail or commercial markets. Some of these hardware manufacturers react to these perceptions by treating further and higher education as markets of secondary commercial importance whilst a very few have created models of constructive engagement and communication that open up possibilities for mutually beneficial collaboration. It would

obviously be ultimately beneficial for learners if there were increased understanding and communication between producers, manufacturers and developers on the one side and further and higher education on the other, and there is perhaps a role for a national forum.

Some of the relatively few developers of software and content for mobile platforms predict a continuation of project-based funding, focussing on engaging new learners and delivering standalone content. They anticipate that some public funders will continue to support exploratory work in order to define the potential of wireless and mobile learning and that there will be a small but growing demand for the localisation and customisation of content, and for more support and training for teachers and lecturers. Institutions of further and higher education should be aware of these possibilities opening up.

The issue of standards is however problematic for developers working in wireless and mobile learning, since many of the technologies are immature, unstable and short-lived, requiring considerable developmental agility. Standards are seen as a potential brake on development, and interoperability may be best achieved using the levels of abstraction provided by browsers and other industry-standard software systems. Institutions of further and higher education should perhaps treat the standards issue pragmatically in order to encourage experimentation and evaluation.

Many different industrial trainers see a growing market for just-in-time training and performance-support delivered on wireless and mobile technologies for private sector organisations. The development of wireless and mobile learning in further and higher education could exploit some of the models of mobile training used in the private sector but might also market its own models of wireless and mobile learning to companies and corporates.

### **Institutional Perspectives**

In order to deploy wireless and mobile learning on a larger and sustained basis, its champions must present their case in ways that address parity with other forms of provision and delivery in terms of institutional concerns such as:

- costs, funding, resourcing
- quality, validation, fitness-for-purpose
- stability and reliability
- monitoring and evaluation
- legal expectations

Within an institution, several different bodies may articulate these various concerns and determine progress on an issue as potentially pervasive and systemic as wireless and mobile learning. This is because it has attributes that impact on major areas of institutional policy such as IT infrastructure and procurement, staff development and training, teaching and learning practices, and quality management. The 'ownership' of each of the relevant policies usually resides with a different institutional custodian, such as the IT, QA and HR departments and their activities interact and interlock in ways that can slow down innovation and improvement.

Technical support staff, within an institution's Computer Centre or IT Department, are usually the custodians of institutional IT policy and when looking at wireless and mobile learning, are responsible for issues such as network security, hardware maintenance, interoperability, software support and IT procurement. All of these are potentially problematic, especially the issues of:

- network security and data protection
- interoperability with institutional software systems such as VLEs/MLEs, e-portfolios, portals, learning objects
- any pre-existing relationships, including procurement, with specific desktop PC

- systems, vendors and manufacturers, and their respective software systems
- support for staff members' and students' own devices.

A wider acceptance of support for student and staff members' own devices is one way that institutions can reduce pressure on their own resources, and this is especially significant if institutions are to exploit the increasing ownership of handheld computers and smartphones. The reluctance of some technical staff to allow academic staff to install software on their 'work' machines is also problematic since it inhibits experimentation and crucially prevents synchronising and backing-up mobile devices.

Technical support staff usually have policy guidelines relating to mandatory, preferred and supported software systems. This policy is obviously derived from their work with desktop and laptop PCs and is potentially unhelpful if applied uncritically to mobile devices where the market-place is still evolving and the balance of the arguments about procurement is bound to be different.

Staff developers are the custodians of institutional HR policy and are faced with the training dimension of large-scale wireless and mobile learning. This may only be resourced if wireless and mobile learning forms part of institutional policy, or at least is not perceived to run counter to other existing policies. There are several models of how staff development could tackle issues of change in education. One model (Hall, 1974) looks at the need to address teachers' and lecturers' anxieties about change as well as addressing the need to up-skill.

If wireless and mobile learning are to become an established part of a course offered by an institution, then the institution's quality assurance procedures, looking at fitness-for-purpose on behalf of students, will expect answers to questions such as:

- Are the proposed course and the student experience comparable to that of a face-to-face course?
- Are the proposed course and its delivery mechanisms fair to all of its students or are some disadvantaged?
- Are the assessment procedures proposed using mobile learning technologies as rigorous, fair and objective as conventional techniques?

These are clearly challenging issues for a new pedagogy to address, and wireless and mobile learning will require 'second-generation' pilots or large-scale trials across institutions and across subjects if its wider potential is to be realised.

Wireless and mobile learning is currently treated by QAA as part of Flexible and Distance Learning in its general guidance to institutions. This guidance is relatively high-level and open to a considerable variety of interpretations at a local level. The view of wireless and mobile learning as fitting within Flexible and Distance Learning is potentially problematic for courses using wireless and mobile devices purely within the classroom. There is however increasing movement towards viewing wireless and mobile learning more holistically and looking at it in terms of a range of parameters including the balance of lone learning vs cohort learning, on-site learning vs off-site learning and face-to-face learning vs remote learning. At a local level, specific institutions ability to validate innovative wireless and mobile learning provision may depend on whether the institution is coming up to or coming away from some inspection or audit, and whether validation procedures are highly formalised and centralised or not.

Every university and college now has a teaching and learning strategy and this usually has an e-learning component. The institutional strategy articulates the roles and responsibilities that underpin the strategy and this will usually include high-level learning and teaching 'champions' responsible for carrying out and carrying forward learning and teaching in the institution. These champions are the custodians of institutional policy on teaching and learning and usually have a lead role in introducing and managing educational change across their institutions. This often involves mustering the resources, training and guidance (or



indeed regulation) for embedding innovation and acting as the 'gatekeepers' to the wider use of wireless and mobile learning. It would usually be their responsibility to implement the practicalities of any institutional wireless and mobile learning policy.

Each of the case studies in (Kukulska-Hulme & Traxler, 2005) deal in part with these institutional issues and one in particular describes the introduction of institution-wide mobile learning.

One final and largely unresolved issue for more sustained wireless and mobile learning is the attitudes of students, potential students and teaching staff. Any initiative to introduce wireless and mobile learning can only successfully proceed if these attitudes have shaped the nature and extent of the initiative, in terms of the acceptability of the proposed devices, technologies, pedagogies and costs.

### **3. Strategic Overview – Possible Trends**

The development of wireless and mobile learning in the post-16 sectors will take place in the context of various trends in the wider technical, social and commercial environment that will have considerable impact.

The leisure, retail, business and commercial markets will continue to drive mobile device design, marketing and pricing. This will mean that educational innovators will have to continue appropriating and adapting hardware and software technologies intended for other markets and other purposes.

It will also mean that many students, perhaps only the more affluent, will enter further and higher education already owning wireless and mobile devices. Educational institutions must accept and exploit this diversity of technologies, devices and connectivity, and use their own resources to maintain equity of access and use for less affluent students.

This will mean that institutions must be very flexible and responsive in working with a proliferation of platforms, systems and networks. There are several likely trends within the overall confusion and these may make the situation more manageable. Handheld computers (PDAs) are likely to continue to lose market share to smart-phones (with considerable connectivity and personal information management functionality), alongside a general migration of PDA functionality and potentiality into smart-phone devices and increased diversity and richness of connectivity. Handheld computers may also lose some market share to laptops and tablet PCs (with wireless connectivity and a widely recognised and accepted interface), though this is less likely to be significant amongst many potential students. The handheld computer market itself may see increased segmentation and fragmentation as manufacturers try to define and exploit progressively more specialised niches, whilst the power and diversity of peripherals (cameras, keyboards, location-sensors) will also continue to increase. There may also be growth in the ownership and use of USB memory sticks (to carry personal content and eventually some processing), personal music players (with personal information management and file space) and games machines. The steady increase in urban and campus connectivity will favour laptops at the expense of handheld computers and phones, especially if GPRS and its successors continue to be rolled out. It seems possible that PalmOS (and Palm) will continue to be under pressure from Microsoft as the dominant platform (and perhaps from Symbian in smartphones).

Community, further and higher education will begin to see raised expectations amongst their younger entrants as wireless and mobile learning become more widespread in schools and sixth-form colleges.

In line with general social trends there will be increasing but unsupported handheld computer use by academic staff and possibly even greater laptop usage (and home-working),

reinforcing concerns about cost issues, the length of the working day, loss of privacy and stress, many of which have already been explored in relation to networked learning (Bacsich et al, 1999).

Institutions in further and higher education currently seem relatively cautious about exploiting wireless and mobile technologies in teaching, learning, assessment and administration and its champions must recognise and explore the issues that this review has raised. These include:

- usability (and this must include SENDA compliance)
- network security
- the diversity and fluidity of devices, platforms and systems
- lack of staff expertise
- procurement, maintenance, ownership issues.

One type of wireless and mobile technology use that is somehow different from most of the others is SMS texting based on mobile phones. It is different mainly because institutions unusually do not have to procure or maintain the hardware – mobile phones are a ubiquitous and inclusive technology - and need only pay for bulk messages. The usability and interface are poor and the purely pedagogic exploitation is challenging. SMS texting does however present a unique opportunity for institutions to improve retention, efficiency and contact. A few large-scale pilots are now beginning to take place.

#### **4. Recommendations**

We are seeing an increasing and informed diversity of learning, teaching and administration taking place on a range of wireless and mobile devices; we can also expect to see a continued improvement in the performance, usability and connectivity of mobile devices and a gradual understanding of the affordances of mobile learning in the wider context of technology supported learning. This section looks at strategies that can take wireless and mobile learning to a sustainable and substantial position in UK post-16 education.

The way forward for an institution will obviously depend on a wide range of local factors, including its students' needs and preferences, its staff's expertise and enthusiasm and the institution's resources and organisation. There are however some tactics that will enhance the success of a wireless and mobile learning strategy:

- Projects will reward and support innovative lecturers, gain and publicise valuable early insights and give wireless and mobile learning positive local visibility.
- Exemplar content, lessons and courses across disciplines will give lecturers a sense of what they themselves could achieve; some of it should be 'quick-and-dirty' and invite imitation.
- High-level 'buy-in', managers seen using wireless and mobile devices, will increase credibility and status of wireless and mobile learning.
- Identification and exploration of potential revenue streams will enhance sustainability; some projects could specifically address this aspect of wireless and mobile learning.
- Recognition that mobile and mobile devices are 'personal' and encourage 'ownership' amongst lecturers – easy access to a range of mobile devices will develop familiarity, expertise and confidence.
- Reliable and robust technical support, infrastructure, network access and hardware will mean that lecturers can innovate – especially in front of 'live' classes - without risk.
- Standards introduced and developed only as experience accumulates, avoiding premature 'lock-in' to specific platforms or systems; the same is true of ways of measuring the progress and success of wireless and mobile learning.
- Sustained, timely and accessible staff development that addresses lecturers' pedagogic and technical worries; mixing 'just-in-case' with 'just-in-time'.

- Credible channels of evaluation, feedback and communication between students, lecturers and management will foster greater 'ownership' of the institutional strategy as it evolves.

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